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FOREST SERVICE

FOREST RESEARCH ACTIVITIES

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FOREST ECONOMICS
RANGE MANAGEMENT
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FOREST RESEARCH

November, 1935

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Foreword

Review of: The Design of Experiments, by R. A. Fisher. Journal of American Statistical Association, December, 1935, Vol. XXX, No. 192, pp. 771-772.

Even statisticians who understand the importance of sampling errors are inclined to collect data first, leaving the study of tests of significance in terms of probability as an afterthought. The like is true of experimenters. But if a careful study of sampling errors is made before the collection of data or the laying down of the experiment, it is generally possible to adjust the technique so as to bring about enormous economies, with increased accuracy of the results. It is not at all uncommon to find one part of a research appropriation expended to obtain a number of cases greatly in excess of those needed, while another part of the same appropriation is left too small to make possible the collection of enough cases within its purview to provide an adequate basis of comparison. In general there is an optimum mode of distributing a limited fund among the parts of an investigation in order to provide the most sensitive possible test of any particular hypothesis; the determination of this optimum is a problem involving sampling errors.

Professor Fisher, whose work on sampling distributions has been of the highest importance, now contributes a work on the efficient design of experiments. The principles involved in the agricultural experimentation which supplies his chief illustrations are also applicable to a variety of inquiries in the domain of the social sciences, though these sciences are scarcely mentioned in the book. One thinks of questionnaire investigations, tests by means of keyed advertising, estimates of production and prices based on selected samples, mental testing programs, and efficiency studies. Economic experimentation on a grand scale has recently been espoused in the highest official quarters, but evidently without knowledge of the principles that must be observed if an experiment is to yield information.

After a convincing account of his theory of inductive inference, the author illustrates a sequence of situations of increasing complexity in which hypotheses can be tested efficiently by means of experiments of suitable design, or inefficiently by such experiments as might first occur to one. The simplest of these relates to a lady's claim that she can tell by taste whether tea or milk has been put into the cup first. The necessity of an element of randomness in the arrangement is made clear.

The chapter on Latin and Graeco-Latin square designs is of great interest. If differences of yield are to be investigated among varieties A, B, C, and D of potatoes, a field may be divided into four

rows and four columns. A Latin square arrangement is one in which no two plots in the same row or the same column contain the same variety. An efficient design for this experiment would involve a random choice among the 576 possible 4 x 4 Latin squares. But at the same time, on the same ground, another experiment can be carried out, for example, to determine the relative efficacies of four different fertilizers. Even a third experiment, for example on the effects of different methods of cultivation, can be applied simultaneously. If an appropriate Graeco-Latin square is used, these three experiments do not at all interfere with one another. Indeed, at almost no increase in cost over one of them alone, they give much more information than if all three were to be carried out separately, for the simultaneous experiment throws light on the interactions, or non-linear combinations of effects. The results are also better than those from separate experiments in providing a basis for inductive inferences applicable under a wider class of circumstances. The chapter closes with a logical puzzle reminiscent of the riddles of Lewis Carroll.

Stress is laid on denial of the common belief that in an ideal experiment only one factor is varied at a time, all others being held constant. The chapters on Confounding develop a highly ingenious idea. Increasing the size of a sample in order to diminish standard errors often fails because of the necessity of including heterogeneous material. To avoid this, it is sometimes possible through careful planning to gain the necessary precision by suitable layout of the experiment without increasing the number of cases, but at the sacrifice of knowledge of the more complicated interactions among factors.

A review of one of Darwin's experiments and the calculations he made from it in accordance with Galton's suggestions shows the crudeness of the statistical methods then in vogue. This historic example should be a warning to those who today manipulate data without regard to the theory of probability. The book closes with chapters on the increase of prevision by means of corrections involving concomitant measures and regression equations, on fiducial probability and on the measurement of amount of information, all of which will repay careful study. The exposition is almost completely non-mathematical, though a little calculus is used in the last chapter.

Harold Hotelling
(Columbia University)

(A copy of Fisher's book will be sent to each Station as soon as the copies which have been ordered are received.
E.N.M.)

ALLEGHENY FOREST EXPERIMENT STATION

General

Prospects for cooperation with the Bureau of Entomology and Plant Quarantine in our territory were strengthened by a visit from Dr. C. W. Collins, and T. H. Jones of the Bureau, to both Philadelphia and the Lebanon Branch Station. Dr. Collins is working on the bark beetles chiefly instrumental in spreading the Dutch Elm disease, at the joint laboratory of his Bureau and the Bureau of Plant Industry now located at Morristown, New Jersey. We pointed out to him some of the major insect pests, or insects suspected of doing major damage, in our territory, including particularly the pine shoot moth. An examination of plantations on the Lebanon and at Camp Ockanickon was made but little new shoot moth injury was found. We could find no pupae. Dr. Collins believes that the low temperatures of the past two winters have so reduced this insect in numbers that it will be several years before it is again a serious pest of hard pines in plantations. The Morristown laboratory is willing to cooperate in any insect studies and they have requested that we send them shoot moth material so that the insect can be definitely identified. He and Dr. Jones were somewhat surprised at the variety of insect pests in the oak type and pine type as typified by the Lebanon Experimental Forest. An interesting bit of news on the Dutch Elm disease was Dr. Collins' positive statement that extensive root grafting of native elm in northern New Jersey made clean cutting of swamps containing diseased trees absolutely essential to control.

Branch Stations

Mr. Schnur reports that some progress has been made on the development of the two branch stations which we hope to eventually obtain from the Resettlement Administration.

Stone Valley Branch Station, Central Pennsylvania. On November 12 Mr. Mollenhauer was recalled from his temporary assignment to Beltsville, Maryland, and transferred to Huntingdon, Pennsylvania, to help Mr. Munro, Project Superintendent for the Resettlement Administration, on the development work of the area in which we are interested and to make preliminary plans for our ERA crew which will be put to work as soon as the land is definitely available for our use. A building site has been selected and a 5-foot contour map of this area made. A survey to definitely fix our exterior boundaries has been started and the road development plan is well under way. Mr. Mollenhauer is making efforts to find out the history of the Stone Valley site, especially in regard to timber and logging.

Beltsville Branch Station, Maryland. An ERA crew started work on the Beltsville area during the latter part of October. A plan for preliminary work has been drawn up, the location of the roads

tentatively decided upon, the building site selected, and the architects of the Resettlement Administration have started work on the plans for the buildings.

Management, Allegheny Hardwoods

East Tionesta. Early in November field work on the East Tionesta age study plots with the CCC crew was concluded. Stump sections or V cuts at stump height were obtained from all trees logged to date on the 10 plots established in 1934. A series of sections was obtained from a recently felled white pine tree on Plot #8. This tree was 30.8 inches d.b.h. and 121 feet tall. A complete disk was taken from the stump, from the end of each log, and from the top at each 10-foot interval. Each disk was oriented so that its position on the tree and compass direction may be ascertained. Stem analysis will be made to determine the uniformity of growth on various radii and at various heights in this old tree.

Kane Experimental Forest. 5050 Seeds were planted in screened seed boxes to determine the effect of four methods of treatment, after collection, on the germination of black cherry and pin cherry. These boxes were placed beside Weather Station #3 beneath a 35-year-old second growth stand and at Weather Station #2 in the open, all planting and mulching being uniformly done.

At Philadelphia, in cooperation with Dr. K. D. Doak of the Bureau of Plant Industry, a study was begun to test out methods of seed coat sterilization and cold treatments influencing the germination of black cherry. Seed collected at the Kane Experimental Forest was used for the production of sterile seedlings in Dr. Doak's mycorrhiza study.

Volume tables for northern hardwoods, in alinement chart form, were secured from the Northeastern Forest Experiment Station and checked against tables based on tree measurements made in Pennsylvania. The volume data on all our sample plots in this type will be summarized.

Management, Coastal Plain

The first half of the month was spent at the Lebanon completing this season's work on the improvement thinning experiment. The final task was the measurement of the height of all trees to be left in all plots. In all, the height of 1040 trees was measured. An extension rod with rope and pulley for extending it beyond normal reach was used. This rod could be extended to 23.2 feet from the ground and could then be lifted for an additional 8 or 10 feet. On the average of one tree a minute was measured with this rod.

Cup counts were made under two chestnut oak trees which have been under observation since 1928 at Camp Ockanickon. For one tree 1928, 1930, 1932 and 1934 have been good seed years. The alternate years have been poor seed years. In general the acorn crop was very scanty this year (1935) in southern New Jersey. Our seed production data for South Jersey was summarized and sent to H. I. Baldwin for use in the preparation of the tree seed manual.

In the office, Ogloblin has continued the tabulation of the stand on the plots from the stem maps.

Height over diameter for the four principal oak species has been plotted by Miss Loose. All trees plotted were 13 years old and all were of coppice origin. The relative growth rate of the four species growing under the same conditions is shown in table 1.

Table 1

	White oak	Chestnut oak	Black oak	Scarlet oak
Average d.b.h.	1.72	1.77	1.96	2.10
Average height	16.1	17.6	19.4	20.5
Basis trees	295	315	288	59

Mycorrhiza

Among the various phases of the mycorrhiza work in progress, many are continuous for periods of 5 to 8 months. This also applies to the testing of hosts in pure culture with various fungi and growth studies; some of these need 12 months. Maintenance of the collection of fungi obtained over the past 4 years requires periodical attention. All growth and synthesis results reported for November concern those removed for examination during the month. A summary of the various activities follows.

Seed sterilization and storage. Most of the seed for use in the winter culture experiments was collected, surface-sterilized and placed in cold storage. In some cases the cold storage temperatures were regulated especially for promoting germination, in others to a point where the seed was held dormant in a sterile condition until used. The seeds of many species are entered by fungi and bacteria in various ways then placed in warm storage without sterilization. The species stored in these ways were: *Pinus strobus*, *P. rigida*, *P. resinosa*, *P. taeda*, *P. echinata*, *P. pungens*, *P. radiata*, *Liriodendron tulipifera*, *Tilia americana*, *Quercus palustris*, *Q. ilicifolia* and *Prunus serotina*. These comprise the species for use in experimental work not to be started until May 1936.

Effects of calcium and nitrogen supply on development of conifer mycorrhizae in pure culture. This series was removed for histological study and was identical with a series removed in April 1934. None of the details can be summarized until sectioning has been finished. The earlier results can be summarized as follows. Calcium starvation showed deeper penetration of the Hartig's Network between the cortical cells of short roots, regardless of the nitrogen supply. The mantles surrounding the roots were thickest with the lowest nitrogen supply and thinnest with the highest nitrogen supply, and this relationship was not changed by the calcium supply which affected the Hartig's Network.

Ammonium nitrate, peptone relationship to development of coniferous mycorrhizae. In a mineral nutrient solution, containing nitrate and ammonium forms of nitrogen, two fungi, Boletus granulatus and Boletinus pictis, depressed growth of 4 species of pines, even though mycorrhizae were produced with part of the short roots. With peptone as the only source of nitrogen, mycorrhizae were formed with all short roots and growth was increased. In each of the preceding groups, growth comparison was made with a control group getting the same nutrient but lacking either of the fungi. This relationship agrees with results obtained under similar nutrient conditions with different fungi during the past three years.

A study of the nature of root excretions and their action on bacteria and mycorrhizal fungi, has been started in cooperation with Dr. W. G. Hutchinson, University of Pennsylvania. By pure culture methods the excretions of various species of roots will be obtained, purified and concentrated for testing on the growth of soil bacteria which are found in close association with roots and mycorrhizal fungi. A preliminary study has yielded methods for conducting this work.

Parasitism of coniferous and deciduous roots in pure culture by strains of Armillaria mellea, are being studied in cooperation with Mr. Alfred G. Lisi, University of Pennsylvania.

In preliminary work, one strain of the fungus, Armillaria mellea parasitized living roots of Pinus strobus. The relationship of the strains of this fungus obtained from different hosts on parasitism of hosts with which they do not occur and the differences in processes of parasitism will be studied.

Decay of hardwoods

After having spent 4 1/2 months in the field in Connecticut, Dr. Sleeth, who heads this project for the B. P. I., returned to headquarters at Philadelphia on November 25. A greater part of his time was spent on a butt rot study of oaks. This study was similar to the study being made on butt rots in sprout oaks in the Allegheny region. Some time was used inoculating a number of oaks with fungi,

cytospora and coryneum species, isolated from dying oaks. The inoculating material was collected in Connecticut and the fungi isolated by Mr. R. W. Davidson.

In cooperation with Mr. Bradford Bidwell of the Connecticut Forestry Department a study of Polyporus hispidus decay and associated cankers was made in a badly infected area of the Nehantic Forest near Lyme. All affected trees on a half-acre plot were cut and data taken on the extent of decay and point of entrance. Specimens from the dissected trees were taken and sent to the Washington office for culturing. A survey of the area around the half acre plot was made to determine the distribution and amount of infection. As high as 7 cankered trees to a tenth-acre plot was found, the average being 10-15 cankered trees per acre on an area of approximately 50 acres. Cankers with P. hispidus sporophores were found on rock, black, white and red oaks; however, many of the cankers had no P. hispidus fruiting bodies. The largest number of cankered trees were rock and black oaks. These two species were the more abundant of the oaks in the area surveyed.

APPALACHIAN FOREST EXPERIMENT STATION

Management - Mountains

During the summer and fall 300 seed traps were established on the Bent Creek and Toccoa Experimental Forests by ERA crews. These traps are the initial step in a 10 year seed production study designed to answer the constantly recurring question, "What tree characteristics indicate good seed production?" Seven of the important oaks were chosen for the initial study. Two seed traps were placed under the crowns of several representatives of 3 widely differing tree classes in each species. Each of the traps covers a quarter milacre. In addition to the traps 2 open quarter milacre quadrats were established under each tree for observations on the disappearance of seed during the fall and winter.

Although all traps were not established before the autumn seed fall began, weekly examinations of established traps and open quadrats were carried on. Seed commenced falling the third week in August and continued until the third week in November. The seed crop was scant and approximately 80 per cent of the seed caught in traps was damaged by rodents and/or birds before reaching the traps.

The establishment of the 4 selective logging areas at Parsons, W. Va. and Bastian, Va. was completed with the tallying of reproduction on 90 0.2-acre plots.

A series of 9 half-acre laurel replacement plots was established on the Toccoa Experimental Forest to obtain information on methods by which desirable tree species can be artificially introduced into such areas. The removal of laurel was done in the following ways:

1. Clear cutting.
2. Clear cutting and grubbing.
3. Clear cutting in strips at 12' intervals.
4. Clear cutting and grubbing in strips at 12' intervals.
5. Clear cutting in spots at 12' intervals.
6. Clear cutting and grubbing in spots at 12' intervals.

The man hours required for each of the various methods of site preparation was recorded. Planting of 1-1 white pine stock in these plots was completed in November, various methods of spacing and arranging 3 different grades of the stock being tried to determine a desirable planting technique for such areas.

Experimental Forests

A 1600 acre addition to the Toccoa Experimental Forest in North Georgia, made possible by the acquisition of adjoining private land, was approved by the Forester. This forest now contains an entire watershed of approximately 3900 acres.

Management - Coastal Plain

A cruise of 400 acres of old growth loblolly and shortleaf pine was completed. In nearly every place where shortleaf pine has died it is being replaced with loblolly pine and hardwoods. Relatively little shortleaf reproduction is present on the area.

Pulpwood - A new yield table for loblolly pine stands was completed. This table is for even aged loblolly pine growing in pure or mixed stands as well as in stands of different densities.

New volume tables for second growth loblolly pine were prepared. These tables are consistently lower than all other tables heretofore presented. Two possible reasons for this are that previous volume tables were prepared from trees in only a few stands, as compared to 36 stands sampled in this study, and that data for earlier volume tables were usually taken at log lengths instead of more frequent intervals thus possibly distorting the form of the trees.

Analysis of the factors affecting the amounts of heartwood in second growth loblolly pines has been completed. Final results show a positive correlation of the percentage volume of heartwood with age and a negative correlation with rate of growth.

A series of cordwood converting factors for rough and peeled second growth loblolly pine were based on selective piling of 800 trees and 2500 bolts. A density index table gives a base density to which all loblolly pine stands can be referred.

Nursery studies on the effects of density of stocking in loblolly pine nursery beds were started.

Seeds collected from 150 loblolly pine trees were sown in the nursery and will be planted in January in a study of the effects of characteristics of one parent on the growth and development of the progeny.

A working plan for the establishment of growth plots on National Forests was prepared and 100 plots have been established near Charleston, S. C. by the staff of the Sumter National Forest.

Fire Damage - Mountains

Another in the series of large experimentally burned fire plots was established in a second growth stand of northern hardwoods on the Fernow Experimental Forest in West Virginia. The plot to be burned contains about 10 acres; the check plots include approximately 8 1/2 acres. More than 8000 trees were described and 360 reproduction quadrats were established.

A cooperative study with Region 7 and 8 to learn the amount and duration of tree killing resulting from fires of different severities was begun. The plan calls for the establishment of paired quarter-acre plots around the perimeter of selected burned areas on most of the Ranger Districts within the Station's territory. Of each pair of plots, one is to be within the burned area; the other in the adjacent unburned stand will serve as check. Tallies of dead trees at periodic intervals are expected to furnish valuable information on rate and extent of mortality by species, diameter and crown classes, fire severity classes, etc.

The Byram Haze Meter produced by the Pac. N. W. For. Exp. Sta. has been tested in the Southern Appalachians for distances from 5 to 12 miles inclusive and found to do everything its inventors claim it will do. Test smokes were readily seen at the "visibility - distance" as indicated by the haze meter. Other test smokes sent up beyond the measured "visibility distance" were not distinctly seen.

Smokes for these tests were produced by burning dry hardwood leaves and some dry pine twigs with needles attached in 2 Cyclone trash burners. Occasionally the charge was spiked with small handfuls of green rhododendron leaves. Maximum smoke production was induced by judicious applications of water from a back pack pump at intervals during the burning.

An eyesight test for forest fire lookouts developed by the Pac. N. W. Forest Exp. Sta. was demonstrated at the Pisgah N. F. fire meeting. Copies of the instructions for giving this test were mimeographed and given general circulation to Regional Foresters, Forest Supervisors, and State Foresters throughout the Station's territory. Region 8 has instructed the Rangers throughout its entire region to give this eyesight test each year to each prospective lookout.

Fire Weather

Downs began fire weather forecasting for the fall season October 17. Due to the exceptionally early killing frost and freezing temperature of Oct. 7 the season was some two to three weeks earlier than usual.

Although the accumulated deficiency in precipitation was small most sections had been without rain of any consequence since September 5. The heavy rain of this date, while of flood proportions over the Coastal Plain and the Piedmont, failed to extend, effectively at least, over the mountains.

The early freeze of Oct. 7 killed a comparatively large proportion of the leaves on the trees--but it was not until October 20-23 that sufficient rain and wind occurred to bring down the bulk of the leaves. These rains, however, were too light to give material relief from the drouth, only making matters worse by putting all the leaves on the ground. Consequently, from October 24-27, when the relative humidities sank regularly into the twenties and sometimes below twenty per cent, the fire risk was undoubtedly high, if not extremely high at times. Comparatively high hazard continued until November 5, then frequent rains maintained slight danger until about November 20, the beginning of seven days of moderate to high hazard, culminating in rather numerous fires on the 26th and 27th.

Streamflow - Erosion

Records of the continuous flow of 23 streams from small watersheds representing different kinds of vegetative cover have been obtained for periods ranging from one year to two and one-half years, depending on the time of installation of the different weirs. Intensive analysis of these data is in progress. Summaries have been completed showing normal flow, maximum flow, minimum flow, and maximum diurnal fluctuation by weekly intervals. These show considerable difference between different types of vegetational cover, particularly in maximum flood flow and maximum diurnal fluctuation. In the denuded area in the center of the Copper Basin, where practically all of the vegetation has been killed by the fumes from the copper smelters and considerable erosion has taken place, a maximum peak flow equivalent to 1400 cubic feet per second per square mile has been recorded while, for the same storm a peak flow of only 29 cubic feet was recorded on an adjoining forested area outside of the Basin.

Meteorological records in the Copper Basin have also shown large differences during the past year. For the 6-months period May 1 to Oct. 31, evaporation from a free water surface has been found to amount to 40.4 inches for the denuded zone, 26.6 inches for the grassed zone surrounding it and 6.5 inches for the forested zone outside the basin. Mean wind velocity showed similar differences.

Intensive studies are being concentrated on the Coweeta Experimental Forest. This area represents the high rainfall belt of the Southern Appalachian Mountains. To date, 17 permanent weir installations have been or will soon be completed. A series of meteorological stations is being developed. Ground water studies are being orientated by means of a system of wells across the main valley

floor. A test flume has been constructed and calibration completed for a special self-cleaning flume required for measuring streamflow carrying such large quantities of silt as to render the use of a ponding basin and weir impractical.

Forest Insect Investigations

To determine the distribution and the rate of distribution of copper sulphate introduced into green shortleaf pines, 164 5-inch trees were treated. Three methods of injection were used - rubber band, "stepping", and "capping". The dosages of the chemical were varied throughout the test. Wood samples taken from these injected trees are being analyzed quantitatively for copper following a method developed by R. H. Carter of the Insecticide Division of the Bureau of Entomology and Plant Quarantine. These analyses will show the amount of chemical present from the outer rings to the center of the bole and from the base to a 20 foot height in each tree treated. Also the rate of intake for various dosages of copper sulphate will be shown.

In an attempt to compare the value of the method of chemical injection into green wood as used at Bent Creek with commercial methods of chemical impregnation, 50 4-inch shortleaf pines were treated with preservatives. Ten trees were "stepped" in each of the following: copper sulphate, mercuric chloride, zinc chloride, sodium arsenite, and sodium fluoride. Each of these trees and each of 10 untreated or check pines were cut into ten 2-foot sections. One half of the sections was buried in an area heavily infested with termites near Saucier, Mississippi, the other half at Bent Creek. Wood samples from various parts of the chemically treated trees will be analyzed to show the concentration of the chemical at different points in the bole.

White Grub Investigations - Throughout the summer and autumn, June beetle collections were made nightly to determine the abundance of Phyllophaga species and the host preference of each species. Test plots were established in the State Forest Nursery at Georgetown, South Carolina to study, along with various phases of white grub life histories, the effectiveness of chemical and mechanical controls against white grubs and June beetles and the effects of these same chemicals on seedlings.

Seasonal Moisture Variation - Twenty 8-inch shortleaf pines were sampled during the mid-summer and mid-autumn seasons, as had been done in mid-winter and mid-spring. Determinations of the amount of moisture present in the wood at the various seasons were made. The results of each season's collection will be compared with those of the other seasons to show the variation of moisture in pines during the calendar year 1935. It is planned to sample these same trees throughout or for a part of 1936.

Forest Pathology

E. E. Roth has practically completed the investigation of butt decay in stump sprouts on the George Washington National Forest. Twenty fifth-acre plots of unburned trees on four widely scattered areas on the Forest have been clear cut. On these plots 1584 oak sprouts of the major species, averaging 5.2 inches in diameter, were dissected. About one-fourth of the trees were butt rotted, and in these trees the rot extended to an average height of 42 inches. Factors affecting the incidence of decay in these trees were studied.

Roth has established permanent sample plots to study the decay hazard in the thinning of twin sprouts, the effect of time of year of cutting and extent of canopy removed on the height at which oak stumps sprout, the decay hazard and rate of healing on pruning wounds of oaks, and a comparison of the rate of decay of cross ties with and without a hidden stage of decay when put in use.

A vascular wilt disease of mimosa (Albizzia julibrissin), apparently new to this country was discovered at Tryon, N. C.; near Bishopville, S. C.; and at Biltmore, N. C. Large numbers of trees have died at Tryon and Bishopville within the past 2 or 3 years, and one tree was found dying in Biltmore Forest. Hepting's work to date indicates that the disease is caused by a species of Fusarium. A similar disease of this tree species was reported in Russia in 1920. Although the symptoms of the two diseases seem to be the same further work is necessary before the two can be said to be the same disease. Inoculation experiments have been initiated to establish the identity of the organism responsible for the disease here.

Three leaf and twig diseases of hemlock have been of local importance in the region this summer. One, apparently caused by the rust Melampsora farlowii, has been doing extensive damage on hemlock in one nursery, and occasionally on ornamental and forest grown trees. Control work will be started at the affected nursery next spring. A disease of hemlock leaves and twigs caused by a species of Rosellinia has appeared to be locally important on young forest-grown hemlock near Pisgah Forest. The mycelium of the fungus involved is largely if not entirely superficial, and can be seen easily with the naked eye. The third hemlock leaf disease found is that caused by Keithia tsugae, and apparently resulted in little damage.

CALIFORNIA FOREST EXPERIMENT STATION

Forest Management - Pine

Black's Mt. Branch

Planting and seeding experiments were delayed by a light snowfall followed by freezing temperatures as low as 4°F below zero.

About 900 quadrats were seeded with ponderosa and Jeffrey pine seed in an effort to establish seedlings for the study of stock damage. To simulate natural distribution and present concentration of stock and rodents, an area surrounding each quadrat was also seeded. Special seed planters were used to avoid disturbance of the soil and vegetation. Since screens could not be used to exclude rodents, a coating of poison plaster was applied to the seed under direction of the Biological Survey.

Planting in the Big Springs and Burney Mountain brush control areas was delayed by dryness of the soil followed by snow and freezing of the ground. On the whole planting conditions were unfavorable. Two thousand seedlings were set out, in cooperation with the Biological Survey, to determine the extent and character of rabbit damage. Additional seedlings planted by the Region were also numbered and described for the same purpose. Seed spots were established for poisoning tests and to determine the progress of reinvasion of the burned portion by small rodents.

Range Research

Foothill Ranges

An entirely new nursery site has been prepared and the fall seeding of a large number of forage grasses from other regions has been completed. From the work of last year there were indications that later planting might prove more successful for some species, and duplicate plantings, in December and February are planned. Through the courtesy of the Southwestern Station we were able to obtain from that region some additional grasses which so far as we know have never been tried in California. The Buffalo-grass sod received from Aldous at the Kansas Station has at the end of the first year about tripled in area. Surprisingly, some of the native California perennials did not do so well as a number of the introduced species.

Our rodent-enclosures which were forty-two inches above the ground, including a seven-inch strip of valley tin, proved no barrier at all to the Digger ground squirrel. An "overhang" of tin, extending ten inches both inside and outside, has been added and it is hoped that this will prove effective in protecting the plots under observation and excluding the rodents.

The calves started arriving the last week in October and now number forty-eight. Three have been killed by coyotes. We hope to save from sixty to sixty-five calves from our seventy cows. Three coyotes and one bob-cat have been taken in traps since we started trapping four days ago and two other coyotes have been shot by CCC boys.

Under-Secretary Tugwell with a party of nine spent one night and a part of the following day at the Experimental Range during October, and we had an excellent opportunity to go over our plans with him. Dr. Tugwell was particularly interested in the extent to which California ranges have become depleted and in the invasion of introduced annual grasses and other plants.

Pine Ranges

During October CCC boys completed practically all of the absolutely necessary physical construction work which will be needed to start experiments at the Burgess Spring Experimental Range in the spring of 1936. Still to be built are a number of livestock exclosures, a game and rodent exclosure, and a few other improvements of lesser importance. It is hoped that everything will be ready by June 1 when cattle will be admitted on the Experimental Range.

The staking and planting of pine seeds on 836, 1/4-milacre square quadrats was completed by the middle of November. The purpose of the seeding was to obtain seedlings on which the effects of cattle grazing could be observed. A total of 72 seed spots, each containing two to three seeds, was made on and around each quadrat. One half of each quadrat was sown to Jeffrey pine (18 spots) and the other half to ponderosa pine (18 spots). The remaining 36 spots were placed evenly on either side of the quadrat to avoid a seedling island effect confined only to the quadrat. Furthermore, it may become necessary to make records of seedlings growing outside of the quadrat if some of those inside fail to develop.

As a means of protecting the seeds from the depredations of rodents, the seeds were coated with poison containing strychnineas the active ingredient. Tests by E. Horn and W. Fair have indicated that this method of protecting pine seed from rodents and at the same time controlling the rodent population, particularly the white-footed mice, gives promise of yielding the best results under the conditions encountered.

Since the middle of November Gardner has been working on plant data collected at Burgess Spring during the summer. This material is expected to yield information on methods of measuring plant growth and plant changes in the vegetation types encountered on the area. Bently has prepared a few maps of the Burgess Spring layout for submission to the draftsman. Hormay spent the latter half of October and the first half of November on the Special Range Report.

Erosion-Streamflow

Forestation

Extensive experiments with seeds of coniferous species have been undertaken in order to find out whether ordinary greenhouse germination practice gives reliable information in regard to the germination capacity of seed. So far it has been found that only in a few cases does greenhouse germination give reliable information. For the majority of California conifers the straight greenhouse germination tests are meaningless.

In order to determine the full potential germination capacity of seed, it is necessary to stratify them in a moist medium at a low temperature for a prolonged period. In no case was it found that pre-germination chilling is harmful to the germination of California conifers. In many instances it is decidedly beneficial as far as increase in percentage of germinated seed is concerned, and in some cases it is absolutely necessary in order to induce germination.

Erosion-Streamflow

North Fork. An instrument has been developed for studying the melting characteristics of snow. By its use the rates of melting and of evaporation-sublimation can be studied in the field. A supplementary unit is designed to measure the percolation rate of water melted from the snow. This equipment was designed for use in conjunction with the Station runoff and erosion plots which are located in areas where snow may occur. Data furnished by the two units are to be used for those periods when runoff is caused by snow melting. It is hoped that the units will be installed under all different cover and soil conditions encountered on the North Fork and Bass Lake plots.

Strawberry Canyon. Some time ago it was noted that the water tables in two natural-soil-block lysimeters showed height variations from day to day, even though the drain valves were closed and their soil surfaces capped to minimize evaporation. The height of the water-table is shown by the height of water in a glass tube outside the tank, opening into the soil block at its base. Observations including the measurement of water-table height and surface-soil temperatures have been made several times daily during the last month. The water-table height variations seem to be of such a magnitude as to indicate changes in surface tension of the soil water possibly induced by temperature changes. To date no detailed analysis of the data has been attempted.

Southern California. The WEC plots on the San Antonio Burn are completed and ready for the rainy season, with recorders in operation. A study has been initiated to determine the efficiency of erosion pins in measuring soil losses from watersheds. About 200 pins have been set out at 20-foot intervals in a small burned drainage area,

with an earth-fill dam at its foot to retain eroded material as a check on erosion-pin results. Volume-weights have been established for the soil in place and will be determined for the reservoir catch.

Three small storms, the largest accompanied by less than a half-inch of rain, caused no appreciable surface runoff. These, however, in addition to decreased transpiration resulting from cooler weather, have increased channel recharge so that all except three of our large gaging stations now have continuous flow.

Fire Research

Transportation Planning

Field work has been completed on the transportation plans for the five forests set up for the project this season. Compilation work has gone forward rapidly and conferences have been held during October and November on plans for the following forests: Mono, Inyo, Shasta, Modoc, and Plumas. A conference will be held on the revised plan being prepared for the Mendocino early in December. Following the conferences the preparation of final drafts of the plans and final reports will complete each project. With the completion of these five projects, up to date plans of transportation to meet hour control standards and improve fire organizations will be available for all forests of the region except the Trinity, which will be undertaken early in 1936.

Much of the recent work has concerned itself with integrating the huge Ponderosa Way fire break with forest plans, and with adapting principles developed for the southern chaparral forests to brush areas within the protection units of the more northern pine forests.

Fire Break Study

A special study has been initiated to better define the value, efficacy and costs of fire breaks in chaparral cover. Mr. George H. Cecil, Secretary-Treasurer of the Conservation Association of Los Angeles County, under temporary appointment with the Experiment Station, is initiating this study. His special interest, long experience, and familiarity with the territory most concerned assure a good start on this pressing problem.

Forest Products and Economics

Logging and Milling Studies

Field work on the McCloud River Lumber Company study was completed the first part of November. One hundred ponderosa pine trees, ranging from 11 to 57 inches in d.b.h. were selected to represent the normal range of quality variation and rate of growth, particularly in the smaller size classes. All trees were photographed from

a distance so that the entire crowns would appear within the limits of each film and also from a range close enough to show branches and knots in detail on the lower 2 to 3 log lengths. After felling, limbing, and bucking, intensive descriptions were prepared for each log, chiefly by the diagram method. Approximately 7700 boards were produced from the 489 mill-length logs delivered to the headsaw. The boards were numbered (Log numbers) and tallied upon emergence from the edger, grade-marked and tallied on the green chain, put through the dry kilns, graded again rough dry, numbered on the ends (individual board numbers) with band numberers, planed, and given a final surfaced-grade inspection.

In addition to determining the true comparative values of different classes of logs and trees by direct physical correlation between source logs and surfaced shipping grades, this study will furnish some needed specific data on the extent of losses and errors which inevitably occur at large pine mills in lumber production studies which are based on green-chain tallies only. The McCloud mill has five band headrigs. A comparison between log-by-log edger tallies and green-chain tallies now under way indicates that a tally at the edger, before the boards from different study logs have a chance to become intermixed or mixed with lumber from other headrigs, should be made an integral part of every study in mills of this type.

Land Use

Surveys of forest employment in the "5-county area," including the counties from El Dorado north to Butte County show marked seasonality of employment in both sawmills and remanufacturing plants. Index numbers of employment in 1935, for example, averaged about 11 in January, 14 in March, 70 in May, 100 in August, 87 in October, and 15 in December. About 45 percent of the employees in the lumbering industry of the area maintain families, usually in towns or on ranches at lower elevations, about 35 percent are local single men, while about 20 percent are "drifters." Seasonal work, isolation of mills and lack of supplementary employment constitute factors which are of importance in attempts to plan the best use of land.

Logging and milling of timber in the area provide on the average about one man-month of employment for each 13 M board feet of timber cut, production averaging slightly higher in the large band mills. Remanufacture of lumber involves about the same amount of employment per M board feet as does logging and milling. Of the total employment provided by forest utilization during 1934, approximating 17,300 man-months, about 44 percent was provided by large band mills, 16 percent by small mills, 29 percent by remanufacture, and 11 percent by the cutting of minor forest products.

Institute of Forest Genetics

Paulin altimeter records of the elevation of all of the Institute's Progeny Test seed trees of Ponderosa and Jeffrey pines in El Dorado County have been completed.

Assistance has been given to the Soil Conservation Service in the collection of seed of certain local species that were not very plentiful this year.

A recent visitor of exceptional interest to the members of the Institute's staff was Dr. H. G. Champion, Silviculturist of the Forest Research Institute of Dehra Dun, India. Dr. Champion has himself made studies of the heredity of Indian forest trees, and was much impressed with the demonstrations now to be seen at the Institute showing the feasibility of improving forest trees through hybridization and various forms of selection.

Work is just starting on the complete reorganization of the Institute's investigative file to make it conform to Forest Service methods of handling material. Voluminous records are on hand covering the many different phases of research in forest genetics that have been under way here for the past ten years. Once this material is all properly organized, Austin and Righter will devote most of their time to the analysis and interpretation of these back records. Little new investigative work will be undertaken until this back work is well in hand.

Statistical Service

Before leaving for Washington the Director took definite steps to create a new branch of service at this Station, namely a centralized Statistical Service for handling all work of a statistical nature.

This department is to assist the various projects in developing material for statistical analysis, in preparing working plans which will insure the collection of data adequate for reliable statistical analysis, and in analyzing data now on hand.

The response from the technical men of the various projects to avail themselves of this service has been most gratifying. While the present force of four clerks is quite inadequate to handle all the requests, it is hoped that WPA workers or additional help will soon be available.

CENTRAL STATES FOREST EXPERIMENT STATION

GENERAL

Branch Stations. Acquisition of National Forest lands within the proposed Richland experimental forest area in Vinton County, Ohio, continues to lag. However, a nearby tract of 120 acres now under option has been turned over to the Station for seeding and planting experiments.

During November the soil survey was continued until halted by the ground freezing. The E.R.A. crew under Cochran has been used to salvage blight-killed chestnut on optioned land for telephone poles and posts. Also, about 9 thousand small chestnut stakes have been split for markers in seeding and seedling studies.

At the Shawnee Experimental Forest quadrats for studying natural reproduction have been protected by enclosing them with galvanized wire. Over 5,000 plot stakes of mulberry wood, and several thousand #9 wire pins for marking seedlings have been made by C.C.C. boys.

FORESTATION

Seed. Extraction and measurement of seed collections made in Ohio and in southern Illinois have continued.

Seeding. A portion of an eroded field on the Shawnee Experimental Forest which Kuenzel treated with leaf litter was planted to black locust and seeded to red oak, mockernut and shagbark hickory, and yellow poplar. Planted trees and seed spots were marked with numbered stakes in order that germination, survival and growth of tree species could be carefully observed on the treated and untreated areas.

FOREST SOILS

Auten has completed the laboratory work, with Myer's assistance, on the study of the effect of forest cover in southern Ohio on Muskingum silt loam, a rather poor soil derived from sandstone and shale.

FOREST MANAGEMENT

Farm Woodland Sustained Yield Project. A meeting of the agencies cooperating in the Dubois County sustained yield project was held in Lafayette, Indiana, on November 5. It was decided that the report would be mimeographed by the Forest Service office in Milwaukee, and later revised for printing by the Purdue department. Approval was also expressed of the plans for initiating the field program. The Purdue Agricultural Extension Service has provided funds to employ an assistant extension forester who will devote a large portion of his time to the project. Present plans may be changed or expanded if this is found necessary after a trial period.

Upland Hardwoods. A number of growth and T.S.I. plots are being established on the Shawnee Experimental Forest by Kuenzel, assisted by Edwin Warner and a 25-man C.C.C. crew provided from Camp Hicks. Plans for future work in cutting and treatment are being prepared.

When Dr. Liming, temporary pathologist of the Bureau of Plant Industry, visited the Shawnee Experimental Forest, he was particularly impressed by the fact that decay in oaks apparently did not progress as rapidly in southern Illinois as in other regions he had visited. He has come to the conclusion that the present T.S.I. policy of eliminating all diseased trees may be modified, since many trees, showing evidence of fire scars and decay, may still grow rapidly for ten or twenty years and gain more in growth than they would lose in decay. This suggests the need for further studies of decay.

Day attended a T.S.I. school conducted by Wales and Maddox of the Milwaukee office. Approximately 45 technical foremen and camp superintendents from Illinois and Indiana units of the Forest Service were present. The meeting was particularly valuable in bringing the viewpoints of the Station and the administrative personnel into closer accord.

Destruction of aluminum tree tags by squirrels in southern Illinois has made it necessary to use painted numbers in plots. Kuenzel is investigating the reasons for this damage, and prevention by use of other materials for tags.

FOREST INSECTS

On an inspection trip through the Shawnee State Forest in southern Ohio, Hall found the tip moth present in practically all plantations and native pine areas visited, but in no place could it be considered as causing more than light injury. An examination of numerous pupae showed a very high percentage of parasitism, which may which may account for the relatively light damage.

Some evidence of bark beetle attack in native pine was observed along recently constructed truck trails, but in only one instance was more than an occasional tree killed.

LAKE STATES FOREST EXPERIMENT STATION

Erosion Survey

A survey of the erosion situation in the unglaciated area of Wisconsin will be begun in the near future in cooperation with the Forest Survey. The purpose is to collect data relative to the causes, kinds, and amount of erosion on wooded slopes. The present plan for conducting the survey consists in selecting several townships and studying them intensively. A beginning will be made in a township near Richland Center, Wisconsin. The first step will be to make a reliable forest cover map; then every tenth farm in the township will be visited and a map made to show the kind and amount of erosion present and its apparent causes. Data on the depletion of woodlots, forest growth and distribution of growing stock by age classes, and species, etc., will be collected for use by the Forest Survey as well as in the erosion studies.

Lysimeters

Last year considerable trouble was caused by snow drifting over the lysimeters in an uneven mantle. In order to obviate this difficulty, a system of double snow fences has been established. Two barriers separated by an interval of 15-20 feet were built along the upper sides and ends of the lysimeter area. It is hoped that these snow fences will prevent the formation of uneven drifts.

Shelterbelt Influences

Progress is being made in the intensive study of the influence of shelterbelts on climatic factors. Artificial barriers which simulate windbreaks have been constructed from boards. The main set-up is at Huron, S. D., but supplemental studies are underway in the other plains states. Various densities of windbreak are represented by using different spacing between the boards. The boards are set endwise and the upper seven feet are left unsupported so that they can move back and forth with the wind. Wind velocities at different elevations and distances from the barriers are determined by a series of anenometers. The density, height and orientation of the shelterbelts all have definite effects on the wind velocity and these are being studied and analyzed.

Forest Survey

The field work of the Forest Survey in Michigan was completed in October and the crews are now beginning work in the woodlot section of Wisconsin.

Seed Testing

The seed laboratory has begun a large number of tests of seeds which will be used next spring for shelterbelt and national forest planting. This year, many tests are being run for the National Forests in Illinois, Indiana, and Ohio, as well as for the older established units in Region 9, and for the Shelterbelt Project.

Selective Cutting of Northern Hardwoods

The plot in the heavy selection cutting made at Dukes in 1930 was remeasured. The growth of some individual trees has been excellent, but the heavy cutting and the leaving of a number of inferior trees in an effort to maintain a definite spacing has resulted in relatively high mortality and consequently a low net growth per acre.

Extension of Hemlock Range

A stand containing eastern hemlock discovered by members of the State Forest Service just east of Mille Lacs in Minnesota was recently visited by Rudolf and Roe of the Station. Three trees were found, the largest of which was 20 inches in diameter and 73 feet in height. So far as is known this area represents the westernmost occurrence of this species. Other stations for hemlock have been reported in Minnesota, all considerably east of the above location, but, with the exception of two trees near Duluth, have been destroyed by the severe fires of 1918 and subsequent years.

National Emergency Council Meeting

The Station prepared a number of charts of forest research work for exhibition at a meeting of the National Emergency Council of St. Paul. The exhibition material was on display in a downtown hotel. The Station was also represented at the meetings.

Director Back on the Job

The Director, now fully recovered, is back on the job.

NORTHERN ROCKY MOUNTAIN FOREST & RANGE EXPERIMENT STATION

General

Sixty-two emergency employees are now at work at Station headquarters aiding staff members in compilation and analysis of field data. This emergency organization is composed of 20 E.C.W. Junior Foresters and Range Examiners, 3 ECW Clerks, and 2 E.C.W. draftsmen, 11 E.R.A. relief rollers and 2 ten percenters, 16 C.C.C. enrollees, and 8 N.Y.A. University students. The C.C.C. boys were selected by members of the staff from the large winter camp at the Region One Remount Station. Most of the boys so selected have proved to be good, capable workers. The N.Y.A. part-time students are contributed by the University of Montana. These boys were only recently obtained and all are either first or second year men in the Forestry School.

Improvement construction, and maintenance work is being continued. At the Priest River Experimental Forest, Superintendent Thompson is going ahead with a heavy headquarters construction program, in addition to stand improvement and hazard reduction work. He has available a selected crew of 15 E.R.A. In addition, he is superintendent of C.C.C. Camp F-127.

Erosion-Streamflow

Fourteen months have passed since 253,000 acres of the Selway and Lochsa river drainages burned in the summer of 1934. During that period above normal precipitation in the fall of 1934 and winter of 1934-35 caused no appreciable erosion within the burned area. Sudden thunderstorms during June and July, 1935, yielding less than 0.4 inches of rain per storm, however, caused gullying over wide areas and heavy damage in the bottoms of streams and dry draws. Sufficient gravel and debris were washed from three streams to completely dam the Selway river for several minutes.

Recent examination of this area by G. L. Hayes, shows that all of the low country and intermediate slopes within the burn are now covered with vegetation to an average of 40 to 60 percent of complete density. On the higher ridges the density decreases to only 10 to 20 percent. Where green timber existed before the fire, the most abundant species are thimbleberry (Rubus parviflorum) and bracken fern (Pteridium aquilinum). Sprouts of all the native brush species are by far the most prominent on the "second-burn" areas. This brush is from 3 to 6 feet high, varying with species. Practically the whole ground area now has a thin protective layer of duff from these deciduous shrubs and the herbs. Within another year or two this duff layer should be adequate to hold the quantities of rain which caused so much damage last summer.

Residents of the Selway-Lochsa region report that these rivers reached the lowest levels in September, 1935, that they had ever seen, in spite of the fact that snowfall was above normal last winter and the summer months were not particularly dry.

Fire Research

A new model pocket-sized sling psychrometer has been discovered recently by this Station which is better in several respects than the pocket-model instrument which we have been using for the last several years. A tabular comparison follows:

	Tycos Model	Foxboro Model
Cost complete with leather case:	$12.50	$6.00
Cost of single thermometers:	2.25	1.50
Case:	leather, over aluminum frame	
Length, over all:	7"	7"
Weight, including psychrometer:	85 gm	117 gm
Scale graduations: Engraved on stems by degrees F.:	0° to 100°	30° to 110°
Broken bulbs replaced:	By use of soldering iron. Difficult and inconvenient.	By use of screw driver

An informal conference on snow surveys was held at Salt Lake City at the time of the fourth annual conference of the National Reclamation Association, November 15 and 16. Some 18 or 20 men were present at one of these meetings, including M. W. Hayes of the Washington Office of the Weather Bureau, Professor J. E. Church of the Nevada Agricultural Experiment Station, Professor George Dewey Clyde of Utah State Agricultural College, and R. L. Parshall of the Colorado Agricultural Experiment Station. Gisborne represented the Northern Rocky Mountain Forest Experiment Station. W. W. McLaughlin, Chief of the Division of Irrigation, Bureau of Agricultural Engineering, Berkeley, California, was the leader of the other informal meeting, at which he outlined the plans of his Bureau to extend snow surveys and run-off forecasts to all major irrigation streams of the west. The Bureau of Agricultural Engineering will select the courses and furnish the equipment needed on all important irrigation streams.

Mr. McLaughlin has offered this Station the opportunity to buy the improved Mount Rose snow sampling outfits under the low bid price obtained by his Bureau in purchasing 150 complete outfits from Friez and Company. By this bid the tubes, in 30-inch sections, cost about $3.40 per foot and the scales about $8.00 each. No quotation was received on the hanger or on extra cutters.

Silviculture

Ordinarily it would not be supposed that planting would encounter a serious brushfield problem in our more northern latitudes. The western white pine type, however, does present such a problem. Near Bovill and Elk River, Idaho are extensive areas that were logged with donkey engines and broadcast burned about 20 years ago. The scarcity of snags and down logs on much of the area indicates that later fires have run over the ground since the original burn. The brush is very dense and is composed of about 85 percent willow and the remainder mostly Ceanothus sanguineous. It is approximately 7 to 10 feet tall and 15 to 20 years old. Except on some north slopes and in heads of draws, natural reproduction is very scarce. An intensive white pine and Ribes survey by the Blister Rust Control office which covered 3,770 acres of this brushfield area shows that less than 20 percent of it contains white pine reproduction to the extent of 100 or more trees per acre. Further indications are that over half of the area has no white pine reproduction at all. As there is no available source of seed, no further natural regeneration of the area can be expected.

Much of the 165,000 acres of logged-off lands donated to the Forest Service by several large lumber companies in this locality is brush-covered land of this sort. Moreover, it is highly productive loess soil similar to and contiguous to the Palouse wheat country, and as fertile for timber growing as that is for grain. This locality, in fact, contains several sections of land which produced the heaviest known cuts of white pine ever logged in northern Idaho. Several timber claims are said upon good authority, to have cruised 10 to 12 million board feet of white pine to the quarter section. Ultimately forest land as productive as this will be planted, and the Station, therefore started during the fall experimental methods of treating the brush preparatory to planting.

The plan is to burn off the brush and to plant in parallel strips cleared with a bulldozer. Check planting under the brush will also be done. In cooperation with Planting Chief Melis and Forest Supervisor Fitting, Weidman helped select the area and then laid out the work on the ground. A Cletrac 55 was used on the job for about 10 days. First a fire-line was constructed around an area of approximately 75 acres. It was intended to burn this over and plant during the fall. Cloudy skies and high humidity came before this could be done, and burning will now have to be postponed until spring or next fall.

After the fire-line was finished the bulldozer was used in making parallel cleared strips in an area of about 4 acres outside the line and in an adjacent area of equal size just inside the line. Strips 8 feet wide were run about 12 feet apart between edges. By planting trees 6 feet apart in each strip the rows of trees will be 20 feet apart, and the total number of trees will be 362 per acre.

Owing to the deep, loose soil and the absence of rocks, it was possible for the bulldozer to do an excellent job of getting out the roots of the brush. More top soil was removed than desirable, but this cannot be avoided with a blade which is not equipped with teeth. On the whole, it is believed that very few, if any, roots were left and that planted trees will have a good chance to develop and overtop the brush before the roots of brush will invade the strip and offer serious competition.

The effect of density of residual overwood upon the development of white pine reproduction was well brought out from information collected during the past summer on a number of old cutting areas. The following data show the relation between density of overwood and growth of white pine seedlings on two representative cutting areas on extensive flats in the Kaniksu National Forest. In each case the sample plots are comparable in all respects but for density of overwood. All plots are one-tenth acre in area.

Area 1. Growth of 16-year white pine under four densities of overwood.

Plot No.	Overwood-Sq. Ft. of Basal Area per acre	White Pine Growth Data		Seedlings per Acre.	
		Ave. Ht. of °Dominant Seedlings	Leader Growth of Dom. Seedl. for past 5 yrs.	White Pine	All Species
1	26	6.7 ft.	3.2 ft.	3,480	4,440
2	59	2.6 ft.	1.3 ft.	5,720	7,920
3	95	1.6 ft.	0.7 ft.	5,360	15,880
4	150	0.7 ft.	0.3 ft.	1,520	8,400

°The most vigorous seedling on each milacre quadrat.

Area 2. Growth of 11-year white pine under three densities of overwood.

Plot No.	Overwood-Sq. Ft. of Basal Area per Acre	White Pine Growth Data		Seedlings per Acre	
		Ave. Ht. of °Dominant Seedlings	Leader Growth of Dom. Seedl. for Past 5 yrs.	White Pine	All Species
1	38	2.7 ft.	2.0 ft.	2,760	12,280
2	93	1.3 ft.	0.9 ft.	3,640	9,080
3	181	0.4 ft.	0.2 ft.	1,080	2,120

°The most vigorous seedling on each milacre quadrat.

The relation represented by the figures in the two tables is applicable to flats only, because indications are that the effect of a given amount of overwood is greater on north slopes and less on south slopes than on flats. No attempt was made to segregate the effect of shade from root competition and the results can be interpreted only as the total effect of the residual overwood. To further study the effect of overwood upon the development of reproduction it is planned to correlate density, and species of overwood, slope, and aspect with light intensity.

Range Research

Because of snow, ERA work at the Vigilante Experimental range was halted about the middle of November and Dobrinz came into Missoula to do compilation work. In addition to clearing about four acres of brush near the headquarters at Vigilante, cutting and stacking fifteen cords of firewood, and making more than 700 fence jacks, 5000 posts for jacks and 3000 poles were cut before the advent of bad weather.

Woolfolk continued the fencing work with two ERA shifts on the new sheep setup at Miles City in spite of some snow and cold weather. The outside boundary fance has been very nearly completed, and work on the division fences started.

The cows were moved from the summer pastures at Hogback Well on October 30, half a month before schedule because of feed shortage, to winter pastures at the Lone Pine.

Ellisons analysis of data for heavily overgrazed and properly used ranges near Miles City reveals sharp changes in composition. The comparison is based upon a transect of meter square plots, 100 on the overgrazed range and 50 on the moderately used range.

	Overgrazed		Moderately Grazed	
	sq.cm. per m.	percent	sq. cm. per m.	percent
High-value grasses	60.00	8.0	606.14	47.2
Medium-value grasses	1.33	0.2	27.96	2.2
Low-value grasses	27.25	4.0	.20	T
Browse & misc. weeds	636.50	87.8	649.12	50.6

The amount of browse is much the same under both conditions of use. The moderately-grazed range, however, has less low-value grass, twenty times more medium-value grass and ten times more high-value grass than the overgrazed range. On the overgrazed range only about ten percent of the vegetation can be classed as good forage, as against fifty percent on the moderately-grazed range. What do these figures mean in terms of livestock carrying capacity, using 5.0 forage acres for a cow, for nine months, and 2.0 forage acres for a sheep?

		F.A.F.	F.A. Per Sec.	A section will support for 9 months
Overgrazed	Cattle	.0098	6.27	1.25
	Sheep	.0145	9.28	4.64
Moderately grazed	Cattle	.0570	36.48	7.29
	Sheep	.0578	36.97	18.48

Analyses of the Miles City quadrats charted between 1932 and 1935, although still in the preliminary stages, have indicated some surprising facts as to the behavior of individual species under drought conditions and have pointed toward possible improvements in quadrat technic.

There was a general decrease of all but one of the principal forage species, as the following averages from 25 quadrats show:

Species	Percentage in 1935 of 1933 area
Grama grass (*Bouteloua gracilis*)	32.7
Niggerwool (*Carex filifolia*)	68.4
Buffalo grass (*Buchloe dactyloides*)	25.8
Bluestem wheatgrass (*Agropyron smithii*)	25.1
Little bluegrass (*Poa sandbergii*)	402.3

Thus there was a decrease of between 65 and 75 percent for the three species other than *Carex* and *Poa*. The astonishing fourfold increase of *Poa* may be laid in part to its habits of developing early in the spring and even getting a start the preceding fall, for both of which the two seasons previous to the 1935 charting were favorable.

It has been shown, although not conclusively, that small tufts of *Bouteloua gracilis* are reduced by drought more severely than large ones, which indicates that the breaking up of large clumps into small ones does not in itself increase their chances for survival.

Forest Products

Service records of ties in the Northern Pacific test track at Thompson Falls, Montana, installed in 1915, were brought up to date through an inspection. The primary purpose of the test was to determine the comparative durability of Douglas fir, white fir, ponderosa pine, lodgepole pine, and western larch ties when laid under similar conditions of service in main line track. A secondary purpose was to compare the value of Vignales rail chairs of several types with standard Northern Pacific plates in reducing mechanical wear and splitting. A total of 1675 ties, of which 1575 were creosoted according to standard practice of the railway company and 100 untreated ties, were laid. Approximately 97 percent of the ponderosa pine ties, 33 percent of the western larch, and 14 percent of the Douglas fir ties laid were treated sawed ties. All of the treated lodgepole pine and Douglas fir ties laid were hewed ties.

All untreated ties consisting of 50 mountain Douglas fir and 50 western larch were replaced during the period from 1921 to 1926 on account of decay. Average life of these untreated ties was 7.0 years for the western larch and 7.5 years for the Douglas fir.

Prior to 1925 only 14 of the treated ties had been removed, including 6 taken out by the Chief Engineer while making a special examination of the Vignales rail chairs in April 1923. In 1925 the entire test track was relaid with new rails and when the rails were changed all of the old Northern Pacific tie plates and Vignales rail chairs were replaced with the new or latest type of Northern Pacific tie plates, 7-3/4" x 10-7/8" in size. Ties showing any considerable plate wear were adzed and those in very poor condition on account of being split or badly plate-cut were removed at that time. The result was that after renewing 78 ties in 1925, of which 65 were removed on account of trouble with the Vignales rail chairs, no additional replacements were needed until 1930. Cause for the removal of all Vignales plates in 1925 was that the nuts bolting the plates could not be tightened conveniently. From 1930 to 1934, with a total of only 55 renewals, annual replacements continued to be very light. However, during this 5-year period many of the ties had begun to show considerable deterioration and in 1935, 204 ties were renewed. Practically all of the ties renewed this year were very soft under the plates and unable to hold spikes. Many of them were badly plate-cut and split.

A summary showing total number of renewals for each kind of wood is given on following page:

Species	Number of creosoted ties laid 1915	Total renewals made to 1935, inclusive	
		Number	Percent
Ponderosa pine	409	53	12.9
Western larch	372	73	19.6
White fir	200	48	24.0
Douglas fir	395	105	26.6
Lodgepole pine	199	72	36.2
Totals	1575	351	22.3

While more than 300 ties have been marked for renewal next year, and replacements to be made in succeeding years may change the relative position of some of the species as given in this table, the sawed ponderosa pine ties show much less deterioration from splitting and will undoubtedly prove to have a longer average life than any of the other species in this test.

Forest Survey

The Forest Survey organization finished the fourth field season on November 5th. This season saw the completion of all the field mapping in Spokane, Stevens, and Pend Oreille Counties in Washington and all of Idaho except one ranger district. The latter, the Salmon Mountain district, administered by the Bitterroot Forest, was found to have such a weak base map that placing types on it was next to impossible. The area was photographed this year with the promise of an air-base map for next season.

The work done this past summer filled in several bad holes and completed the mapping in all of Washington for which Region One is responsible and all of our assigned territory in Idaho except as stated. This will enable us to put out statistical reports as to type acreages as soon as the compilation work is done. The latter is progressing slowly. An E.R.A. crew of eight people has been working on map coloring and compilation since the latter part of the summer. These people have proved successful on the coloring and in some cases on the compilation. They are slow on the latter.

Since the greater part of available funds were spent in pushing the field work during the summer, it was necessary to furlough six men at the close of the field season. Eleven of the mappers were retained to get field maps in condition for the final copying, to work up estimates, and to do preparatory work for next season.

One man is still assigned to the insect depletion study with J. C. Evenden and one man is working on requirements and depletion through cutting studies.

It is planned to assign one man to the fire depletion study later in the winter. Preliminary field work for this study was done by the mappers during the summer. Representative fires in the several timber types were mapped as before and after the fire. In some cases good data could be obtained to show the cover condition before the burn from type maps made before that time. In other cases it was necessary for the mapper to reconstruct the previous types from what he could see on the ground. This was attempted only in recent burns in which the evidence of the previous stand was sufficiently plain to be accurately mapped. Comparison of these maps made before and after the fire should give us the basis for determining fire damage with a reasonable degree of accuracy.

R. J. Smith and F. B. Casler were assigned to check-cruise the Spokane Indian Reservation late in the season. With this done the work of check-cruising is about half completed in Washington. No other check-cruising was done during the season. The work of checking the Indian Service estimates for this area was complicated somewhat by the fact that half the timber had been cruised in 1917 and the rest in 1934 under an entirely different set-up, and by the fact that there was a severe insect loss since the 1917 cruise was made. It is planned to devote a larger percentage of next season's funds to check-cruising to bring this phase of the work more in line with the mapping.

In connection with the depletion and requirements studies, Hutchison has recently completed a graphical analysis showing the relationship between the size of farms in Montana and Idaho, and the amount of fencing. This information will be applied to farm census figures to obtain estimates of total fencing by counties from which the annual fence post replacements can be computed.

A curve of net fencing per acre was drawn, based on data from 1228 Federal Land Bank loan applications and from 405 farm survey schedules collected this summer. By net fencing is meant all cross and road fence, plus one-half of the party line fence under joint maintenance. This analysis shows an inverse curvilinear relationship with high ratios of rods-per-acre to acreage for the smallest farms, dropping off sharply to much lower figures for medium and large size farms. The curve jibes very closely with one drawn by Mr. Lodewick of the Pacific Northwest Experiment Station based on similar data from Oregon and Washington.

Another curve showing gross fencing-per-acre was plotted from the data on the 405 farm survey schedules.

PACIFIC NORTHWEST FOREST EXPERIMENT STATION

General

C. F. Korstian, in charge of the Duke Forest at Durham, N.C., was a visitor at the Station during the month. He discussed utilization problems with Lodewick.

Prof. G. Kano, of the Taihoku Imperial University, Taihoku, Formosa, Japan, spent a day at the Station. He discussed selective logging and logging equipment with Brandstrom, and utilization with Lodewick. In company with Johnson he spent the afternoon at the Plylock Corporation plant.

Wilson spoke upon certain inventory phases of planning before meetings sponsored by county planning commissions, twice at Roseburg, Oregon, on November 15, and once at Coquille, Oregon, on November 21, and before a meeting of county planning board staffs in Portland on November 29.

Section of Forest Products

Requests ranged from data on the breaking strength of poles of different sizes through the ignition point of wood to market information. Inquiries were received as to possible markets for black walnut logs, seasoning and finishing of myrtle wood, markets for sugar pine logs and lumber, producers and consumers of bigleaf maple, and outlets for logging and sawmill waste. Several woods have been submitted for identification, among them another sample from the submerged forest of the Columbia River.

Detailed information was furnished the San Francisco Branch of the Federal Reserve Bank as to production and value of ponderosa pine and Douglas fir in Oregon and Washington during the past decade. The Department of Sociology of Willamette University was supplied data showing lumber production, exports, and imports in Oregon and Washington for the past two decades.

Lodewick spent four days in Seattle, obtaining 1935 export data at the Merchants Exchange, conferring with members of the forestry college faculty, making several desirable industrial contacts, and arranging with the Snoqualmie National Forest office for sample discs of the big Douglas fir tree at Mineral.

Management and Marketing of Farm Timber. A considerable portion of Johnson's time was devoted to the farm woodland report. In western Oregon and Washington there are 2,800,000 acres of farm woodland. In 1929, the value of the timber products cut from these areas was $2,500,000. The farm woodlands of this region carry a

stand of about 20 billion feet of timber. This potential resource has been neglected and abused. The woodland has an important place in the farm economy of the region, hence, how they are handled and managed is a matter of public interest.

Mill Studies. Very little progress has been made in the Hines ponderosa study. Data needed to check degrade and footage losses were not obtained from the company until late in the month.

One of the ERA computers has been working on data obtained in several small Douglas fir mills early last spring.

Fiber Identification. The manuscript prepared by Prof. E. S. Harrar and Lodewick will be submitted to TAPPI within a week. It is suggested for adoption as one of the TAPPI series of Standard Testing Methods.

Deterioration of Fire-Killed Timber. A digest of the report on this project has been approved for publication by the three cooperating agencies, and accepted by the Timberman for early publication.

Forest Economics

Logging Economics. Office work on the ponderosa pine project was continued, Richen and Carlson devoting almost their entire time to analysis of yarding, loading, and transportation studies.

At the request of the West Coast Lumberman drawings were made of a proposed truck-mounted loader for Douglas fir logging. This request came as a result of the interest recently aroused in a new type of log loader proposed by Brandstrom in a paper entitled "Logging One Billion Feet of Timber in Ten Years", which he prepared for the Pacific Logging Congress last month. The drawings will be reproduced in the next issue of the West Coast Lumberman.

Brandstrom spent several days with visitors from Europe and Canada, as well as with local lumbermen who called at the office for information on various logging problems.

Land Economics. Analyses of relation of slope to the use of lands for other than forest purposes and the relation of generalized cover types to tax delinquency were continued. Field work was conducted in Coos County determining the amount and location of lands forfeited to the county for unpaid taxes since 1933 and the amount of lands owned by the county in May 1933 and sold prior to October 1935, and compilations of these data are under way.

Cooperation continued with county, State and regional planning, and other agencies. Mr. Wilson, as chairman of the Land Resources Division of the Pacific Northwest Regional Planning Commission, was

called upon to prepare material and attend conferences in connection with policies, procedure and organization. Among these conferences was the November 6 meeting of representatives of private and public forest interests of Idaho, Montana, Oregon, and Washington, over which he presided.

Mensuration

Ponderosa Pine Yield Study. With the completion of the work on the yields of even-aged stands of the Sitka spruce-western hemlock type, the yield study of even-aged ponderosa pine stands was resumed. This study was temporarily shelved last spring owing to serious difficulties arising in the analysis of the data. Conventional, standardized methods of yield table construction and various suggested modifications of them proved to be unsuitable, giving absurd results. Graduating curves were unreliable, due to the massing of eccentric data in certain age classes. Site index curves were finally made by drawing tentative curves for the data sorted by groups and localities. For each curve a tentative site index at 100 years was determined. Then by cross-curving certain intercepts, such as the heights at 30, 50, 70, 120, and 200 years, over site index, the shape of the site index curves was easily obtained and further progress could be made in the study. The next modification adopted was to limit the data composing the graduating curves to a narrow belt of site index classes where the most plots occurred. These graduating curves were anamorphosed and the remaining data were plotted by site index class and curved out. The plottings usually formed straight lines, but not radiating from a common point as under the standard method. In such manner, step by step, the usual technic had to be modified from the beginning to the end. This yield study, which covers the entire range of ponderosa pine, is apparently too comprehensive to be worked up by the present standard procedures. These may have been differences in field procedure among the individual collectors of data, but the difficulties which have arisen are probably due to wide differences in the growing habits of the species in different parts of its range.

Section of Silviculture

Fire Studies. During the month reports were received from the forests of Region 6 on several studies on the Fire Studies program. The lookout reports of all lightning storms seen on or near the national forests indicate that in 1935 the storms were concentrated in July, whereas the greatest number usually occur in August. This season's fire danger station records, particularly the hazard indicator stick records, show that in 1935 the fire season extended further into the fall, and that fuel moisture content was in general lower than in 1934. The forests have found the haze meters to be a real asset in detection work, and although there are already about

100 in use there is a demand for additional instruments. Executives like the haze meter because it gives them reliable information about changes in visibility conditions upon which to base decisions to put up additional lookouts or to put patrols in blind areas. Reports received on the lookout eye test indicate that the supervisors and rangers consider this test a valuable aid in selecting men for lookout positions and will continue to use it.

Work on the analysis of the slash study data has started, and Morris has prepared an outline of procedure. Matthews prepared a set of questions on fire protection finances, organizations, and objectives which will be used as a study guide by the county planning councils in Washington and Oregon.

Pringle Falls Experimental Forest. The 10-man ERA crew and a similar number of CCC men continued work during the month on the several projects under way at Pringle Falls. A great deal of slash piled earlier in the year along the boundary in the construction of a fire-break was burned under about 6 inches of snow. Burning conditions in this vicinity were ideal this fall and several local timber-sales men state that they are the best they have ever known in their experience. Over a great area in central and eastern Oregon, the usual fall rains came in the form of snow, which left the debris bone dry and most easily fired. These conditions very likely increased the percentage of poles and saplings scorched by the slash burning. On one timber-sales area visited by Kolbe a week after the piled slash had been burned, a fire was found burning in the dry duff under a 6-inch blanket of rather dry snow, indicating the dry condition of the fuels.

Methods of Cutting Plots. In 1930 four methods of cutting plots were established by Kolbe on the Malheur National Forest under considerable high pressure from the loggers, who claimed to be anxiously waiting for the chance to cut over the experimental plots. For economic reasons the logging company changed its curring schedule shortly after the areas were marked, and so left these areas high and dry until this past summer. These plots were tagged and remeasured by Junior Forester Beeman, who spent all of November at that chore, to give our permanent sample plots a boost of four areas and an additional 35 acres. The results will be compiled during the winter season.

Forest Survey

Lithographed Type Maps. Proof copies of the lithographed 1/4-inch-to-the-mile type map of northwest Oregon have been received, checked, and returned to the U. S. Geological Survey, Washington, D. C. Proof copies of the other quarters are expected soon and the maps should be available for distribution in a short time. The color scheme used is most satisfactory.

Progress of Field Mapping. Mapping in northeastern Washington and southeastern Oregon continued, with 14 men in the field during November despite adverse weather. These two areas were practically done November 30, and the field force will be reduced starting about December 10, leaving a few men to clean up.

Office Work. Compilation of type areas is progressing more rapidly now and 6 ERA workers have been trained to do this work. Ownership data for eastern Washington and southeastern Oregon are being collected and will be completed in December.

Type Maps Completed. One-inch-to-the-mile type maps of Lake and Jefferson Counties, Oregon, and Kittitas County, Washington, were completed during November.

Pulp Timber Report Completed. A report on the pulp-timber resources of western Oregon and western Washington was completed during November. It contains detailed statistical information on the pulp-timber resources and a short text.

SOUTHERN FOREST EXPERIMENT STATION

Biology

Field investigation by Thos. D. Burleigh show for the time being, at least, that rodents are not a factor in the destruction of pine seed. Further investigation, although relatively inclusive, seems to indicate that the seed-eating birds, meadow lark, mourning dove and various species of sparrows, found in the cut-over pine woods, are responsible for the destruction of much of the pine seed.

Entomology

The protective chemical spray and dipping tests against ambrosia beetle and sap stain in green lumber at Natalbany, Louisiana, were examined on November 1. No beetle activity had occurred, and the tests are inconclusive; the unusually dry weather probably inhibited the beetles.

On November 13, soil poison tests being conducted at Crown Point, Louisiana, in cooperation with the Monsanto Chemical Works, were inspected. To date, termite damage is confined to the untreated checks.

The Seventh Progress Report on the International Termite Exposure Tests has been sent for publication in the Proc. American Wood Preservers' Association.

During October and November quite a few complaints with regard to Lyctus powder-post beetles were received from exporters of seasoned hardwoods. During the depression there has been an accumulation of old stock and consequent damage. Recommendations for control were made along the lines of business management.

A conference was held, on November 15, with representatives of the National Lumber Exporters' Association at New Orleans. Plans were outlined to reduce the losses.

The alfalfa tree hopper and the lesser corn stalk borer continue, in 1935 as in 1934, to be the only serious insects in black locust nurseries in the Gulf States, especially where no control work was done in 1934.

On November 20, two lectures (illustrated) on the history of research on termites in the United States were given; one before the Forestry Club and the other to a class in wood preservation at Louisiana State University at Baton Rouge, Louisiana.

Forest Pathology

In connection with experimental control of nursery diseases of black locust seedlings, trips were made to two nurseries in Louisiana. Surviving seedlings were counted and soil samples collected for pH determination.

A trip was made to eastern Texas and western Louisiana to investigate the dying of pine reported by Mr. R. S. Manley of the Texas Creosoting Co., Orange, Texas. The dying of pine was confined in the main to second-growth longleaf pine on high ground. Death of these trees was apparently not caused by fungi or insect attacks and is probably the cumulative result 4 or 5 abnormally dry growing seasons.

Longleaf pine plantation number 103, which Wakeley established last winter on the Palustris Experimental Forest, was used in a comparative test of different adhesives. Lamb assisted by Civilian Conservation Corps labor sprayed the area with bordeaux mixture containing either casein spreader, linseed oil, or whale-oil soap.

Forest Survey

Fourteen field crews continued work in Georgia Units 3, 4, and 5, finishing the line plot work on four and one half million acres.

Lemieux completed volume table work in Georgia Unit 5 and in Florida Unit 3, starting work in Arkansas #4.

The computing section checked plots representing twelve million acres. The plot checking is now current with the field sheets as they are received. Two hundred thousand cards were punched. Considerable tabulating and computing work was done for the Norris Dam and Florida Unit #1 reports. Cards were made ready for a pulpwood release on Mississippi Unit #3. Morrill completed volume tables for Louisiana Unit 3. Ward continued work compiling pine depletion from the code records.

SOUTHWESTERN FOREST AND RANGE EXPERIMENT STATION

Director Upson, Hendricks and Crafts are in Washington assisting in the preparation of the Range Report. Cassidy is on detail in connection with the Range Economic Survey.

Assistant Silviculturist E. M. Hornibrook was transferred to the Rocky Mountain Forest and Range Experiment Station December 1. Hornibrook came to the Southwestern as Junior Forester in October 1929. His work has been in forest management, where his attention has been given mainly to studies of growth and mensuration. A volume table for ponderosa pine constructed according to the most advanced methods, is one of his outstanding accomplishments. He has also shown a keen interest in and more than a general knowledge of forest pathology, entomology and wildlife.

FOREST MANAGEMENT

Control of Ips in Timber Stand Improvement

Since the inception of timber stand improvement in Region 3 partial peeling has been practiced as a means of reducing Ips broods. Peeled strips about 3 inches wide are alternated with unpeeled strips of the same width. In addition to a saving in labor, the narrow strips left unpeeled are intended to serve as traps on the theory that the beetles will attack but will be unable to develop their broods. It has been found, however, that broods do develop and emerge from the strips. In order to determine how narrow the strips must be to check the development of the broods an experiment was started by E. M. Hornibrook on June 1, 1935. The stand was second-growth ponderosa pine in the Fort Valley Experimental Forest. Sections of poles 4 to 8 inches in diameter were divided into five lots of five logs each. In four lots, strips of bark were left in widths of 2, 3, 4 and 5 inches, and the fifth lot was left entirely unpeeled. A generation of Ips was emerging in the near vicinity, and the logs were attacked with vigor within 24 hours after they were cut. The first maturing adult was observed July 29, or 59 days after the experiment began. Observations were continued until August 4, or 65 days after the first attack. No adults matured in the 2-inch strips although 15 nests were started, 10 of these being abandoned after galleries 2 to 4 inches long had been made. In the remaining 5 nests the larvae died before attaining the pupal stage. In the 3-, 4-, and 5-inch strips, adults developed in proportion to the width of the strip, as shown in the following table.

Number of 4' logs	Width of bark strip in inches	Total number of nuptial chambers	Total number of new adults	Percent of new adults, using the control as 100	Number of new adults per nuptial chamber
5	2	15	0	0.00	0.0
5	3	45	207	17.28	4.6
5	4	46	530	44.24	11.5
5	5	54	684	57.01	12.7
5	Control, no bark removed	88	1198	100.00	13.6

Partial peeling that leaves strips of bark only 2 inches wide is wholly effective; 3-inch strips are fairly effective, but when this width is exceeded the treatment is of doubtful value. Properly executed strip peeling is preferable to clean peeling because it traps beetles which might otherwise attack living trees.

Fire in Restocked Cutover Areas

On October 17 a fire of 91.77 acres occurred in pine saplings and bunchgrass on the north side of Kendrick Mountain on the Kaibab. The area was logged in 1918. Remains of the logging slash, together with pine needles and grass, made a fire hot enough to kill nearly all of the young pines. The grass, mostly Muhlenbergia montana, was not very dense but stood about 2 feet tall and was partly dry from frost. Enough litter occurs even in young pine thickets to support a fire, but it is the grass that carries the fire between groups of pine and enables it to spread rapidly. After seeing a bunch-grass fire in action, one can readily appreciate the viewpoint of the ranger who would like to see the tall grass grazed down in the fall of the year. A noteworthy fact observed on this burn is that the seed trees escaped serious injury. About half of the area was regular Forest Service cutting and the remainder "timber rights" on which only a few rather small seed trees were left. The difference in density of reproduction is outstanding in favor of the Forest Service cutting. It is proposed to examine this area next year to determine to what extent saplings recover, and also to keep records on future pine reproduction. The Coconino and Kaibab now have extensive areas of fairly well restocked cutover land on which bunchgrass creates a high fire hazard.

Observations in the Pine Forests of the Navajo Indian Reservation

The following is from notes by Pearson on a 3-day trip in the Navajo Reservation, accompanied by members of the Soil Conservation Service.

Large areas of pine occur at 7000 to 7500 feet. Small areas have been logged. Two small mills are now in operation. Marking is for the most part conservative. The brush is being lopped without scattering. Scattering would be better, in order to cover more area and avoid forming a cover too dense for pine seedlings. In the forests below 8000 feet reproduction is virtually absent, though in several places I found seedlings or remnants of seedlings which had been all but eaten up by sheep and goats. There are very few cattle. The seedling damage could not be characterized as either "leader" or "needle" damage. The animals here eat everything clear back to the old wood, as they did on the Coconino prior to 1927. They also browse juniper and pinon. The pine forests generally have a fair stand of mountain Muhlenbergia or blue grama, although grass has practically disappeared from some areas. The Muhlenbergia was only moderately grazed, as would be expected even with heavy sheep grazing in the absence of cattle. Portions of the uncut forest are probably too dense to support advance reproduction, because the seedlings found were very slender. Trees in the small pole stage are quite common and have excellent form, even where open-grown. The mature timber, though often dense, is short, indicating a poor site. The annual precipitation, except on the higher ridges, is about 18 inches. It is probably the sandy soil that makes pine forests possible. In seeking an explanation for the poor reproduction, I first investigated the cone production, expecting to find that cone crops are few and far between, as in southern Colorado and parts of the Carson. On the contrary, I found abundant cone litter of several age classes. Making due allowance for deficient rainfall, I would say that heavy grazing, the kind that destroys pine seedlings in their infancy, is the major cause for the failure of pine reproduction in the last 40 to 50 years.

A notable exception to the above conditions, as far as reproduction is concerned, occurs on the long, broad ridge of the Lukachukai mountains. The altitude is estimated at well over 8000 feet. This ridge, which extends for many miles, is characterized by a succession of small parks each one of which contains a shallow lake. These lakes are only 1/2 to 1 mile apart. No doubt most of the water disappears in dry seasons, but the character of the vegetation indicates more or less permanency. Blue grama is the most common grass in these parks, which is rather unexpected at such a high altitude. Much of this park land is occupied by Sneezeweed, Helenium, considered poisonous to livestock.

Bordering the parks, and sometimes encroaching upon them, are good stands of pine seedlings 1 to 3 feet high. Practically all below 3 feet have flat tops from past browsing. On considerable areas, however, there was little evidence of damage during the past year or two. In several places, saplings were above 6 feet tall and were making fine growth. In seeking an explanation for the abundance of seedlings here as compared with the lower pine forests, higher precipitation is the first factor to suggest itself. Although overgrazing appears to have been the rule, the relative inaccessibility of this high country would naturally result in light stocking following years of heavy livestock losses which must have occurred among the Navajos at various times. A few such years coinciding with good pine germination would enable pine seedlings to attain a size sufficient to persist under subsequent browsing.

The situation on the Navajo reservation is interesting in that it recalls former grazing conditions and the remedy applied on some of the national forests. If the numbers of livestock on the Navajo reservation were reduced to normal carrying capacity of the range, and some attention given to preventing extreme concentration, the reproduction problem would right itself in the main. Some areas would probably call for additional measures, as are now needed even on the most conservatively grazed bunch-grass areas of the Coconino and Kaibab.

WILDLIFE RESEARCH

Dr. Walter P. Taylor, Senior Biologist in the Biological Survey, who for many years has worked in close cooperation with this Station, is leaving in a few days to accept his new assignment as director of a newly created wildlife experiment station at College Station, Texas. Region 3, the Experiment Station, and the whole Southwest are going to miss Dr. Taylor. His energy, enthusiasm, breadth of interest, vision and courage are qualities that have made him outstanding among scientific men.

Although a good deal of interest in the proposed new cooperative research unit was expressed by sportsmen and conservationists in Arizona, and the University of Arizona was prepared to provide its part of the three-way plan, the Arizona Game and Fish Commission found itself unable to participate financially in the proposed arrangement

RANGE INVESTIGATIONS

Jornada Experimental Range

Prospects for winter feed in the Jornada region are more favorable now than at any time in the past three years. A seasonal rainfall totaling a little over 6 inches, which fell principally in August, produced an excellent height growth in the perennial grasses. However, because of the sparse flower stalk production, the volume of forage is less than that indicated by the height growth, or that which would be estimated by the casual observer. Winter moisture is assured for the present by a 1-inch rain which fell on November 24. Livestock is in excellent condition.

The poisonous plant eradication work on a 5-acre area located in the Drymaria enclosure has been completed. Inasmuch as *Drymaria holosteoides* is apparently unable to compete with other plants, its eradication is being attempted by inducing other vegetation to grow on the areas usually occupied only by Drymaria. The method by which it is hoped to accomplish this revegetation consists of plowing 8-inch deep furrows at intervals of 3 feet in a direction at right angles to the prevailing winds. These furrows are check-damned at 20-foot intervals and then partially filled with seed-bearing sand.

An additional area is also being furrowed but will receive no further artificial treatment. Here the sand naturally deposited during sandstorms will be relied upon to aid revegetation. The wind-blown sand contains considerable grass and weed seeds and is deposited on the lee of obstructions or in the bottom of depressions. The furrows prevent run-off, thereby giving the soil its full share of moisture; the sand deposited in the furrows provides seed and the "sand mulch" that is so essential to the growth of the semidesert plants considered. A period of high winds on November 22 removed no measurable quantity of sand from the filled furrows. However, the duration of the storm was so short and the sand movement so limited that it could not be determined whether or not the wind deposited any sand in the empty furrows.

Northern Arizona Forest Range

In connection with range investigations at the Fort Valley Branch Station, compilation of data concerning ponderosa pine seedlings on the Wild Bill cattle range has just been completed. On 30 experimental plots scattered over this range, there were 402 pine seedlings this year in addition to advanced reproduction. Of these, 21 percent are 5 years old and 76 percent are 6 years old. The following table shows the death loss by causes.

Seedlings considered		Died in 1935	Factors causing death						
			Drought	Rodent	Stock	Grub	Fungus	Game	Unknown
Number	402	46	22	11	3	2	1	1	6
Percent	100	11.4	5.5	2.7	0.7	0.5	0.2	0.2	1.5

These 402 seedlings are all that remain of the 3,447 seedlings which germinated on these plots since 1927. Previous to this year, 67 percent of the seedlings died from drought, 6 percent from rodent damage, 0.6 percent from stock damage, and damage by many other factors brought the death loss up to 88 percent.

It is interesting to note that even with seedlings 5 and 6 years old, drought is the most important factor deciding survival on the open range.

Seedling mortality caused by stock browsing has been very low. It has been observed in the field that stock browsing on small seedlings is mostly accidental, whereas reproduction with considerable growth, when browsed, is taken at a particular time and only certain parts eaten, which indicates that there is nothing accidental about such browsing. Most of the seedlings begin life in or near grass clumps, weeds, and also inert objects, such as sticks and stones, which provide some protection to the ground's surface. Where the grass or weeds are eaten by cattle, the seedlings may be topped. This accidental injury is found much more often than injury on a seedling not near forage.

Santa Rita Experimental Range

The following timely statement by Frank S. Boice, President of the Arizona Cattle Growers' Association, is taken from a recent issue of the weekly report of that Association:

> "Your banker is a specialist in credit, and you are a specialist in the production of livestock. If you are in a position where the banker makes the decision as to whether or not you shall fix up a watering place, whether you repair your old fence or go on patching it up with scraps of wire you find here and there--then some one in the past has made a mistake, or you are the victim of unfortunate circumstances.

"The only way to correct such a situation is for you to use the money you get this fall for the cattle you sell, to pay off your debt, so that you will be the absolute boss of your outfit. I do not feel that a man actually owns his outfit until the debt against it is so low that he can survive a drouth and a depression and still come out with good credit. The time to protect ourselves against the next drought and the next depression (and they will both come again), is right now, while prices are good.

"I want for you cattlemen the same thing I want for myself--freedom--the freedom that comes from the knowledge that you own and control your own outfit."

Unfortunately there are too many cattlemen in the Southwestern region who find themselves in the predicament indicated by Mr. Boice. They took advantage of the opportunity of borrowing money that they did not actually need when it was easy to get and then were unable to make repayment when the price of cattle dropped. Those that have not been closed out are finding themselves now with very little to show for their efforts at the close of each year. Which, to say the least, is a very unsatisfactory condition not only for the stockmen themselves, but for the smaller communities which are dependent upon them for continued existence.

Among the important ECW projects recently initiated on the Santa Rita is that of spreading flood waters from the summer rains. The Regional Office is sponsoring the project and recently detailed Mr. Randall to the Santa Rita in order to make up a working plan and to supervise carrying it out.

Two areas have been selected for this work. One is in the vicinity of Box Station, which represents a fairly good grass range supporting such grasses as slender grama, Rothrock grama, three-awn, curly-mesquite, and black grama. The second area chosen lies southwest of Middle Corral in pasture 12. Part of this second area is typical of the mesa range, supporting a fair stand of Rothrock grama, while the remaining part typifies the semidesert range with very few perennial grasses at the present time except along the washes. It is in this latter type that the results will be watched with more than passing interest, since the attempt to bring about the spread of perennial grasses ties in very closely with the Gravelly Ridge Restoration project.

Investigations dealing with burroweed eradication are being summarized in a report which it is hoped will provide CCC personnel or others interested, with data that will aid in control of the weeds. Although more complete information on certain phases of the work would be desirable, it will be possible to make a number of rather definite recommendations concerning eradication methods and the types of range on which they may or should be practiced.

One phase of the problem deals with conditions requisite for survival of burroweed seedlings. In this connection, it has been found that few seedlings survive on protected range where there is a good grass cover. On the other hand, the greatest survival has been noted on grazed range where the stand of perennial grasses was poor and where a fair growth of rather unpalatable annuals allowed a slight amount of litter to accumulate. It has also been found - logically enough - that where degree of grazing and erosion change little from year to year, areas supporting the densest stands of mature burroweeds usually also support the largest crop of seedlings.

The Quail Management program on the Santa Rita Experimental Range continues to show interesting results. Despite the rigors of a series of several dry years ending with 1934, very definite results have been secured in the small sanctuaries installed during recent years.

Plots under the worst conditions of the range are showing a slow recovery, but in most instances the rehabilitation of quail food and cover plants has progressed rapidly despite the drought. These conclusively demonstrate the value of the small inviolate sanctuary as a means of increasing quail numbers.

Annual photographic and growth records are kept and at least one sanctuary representative of each vegetative type has been mapped.

Trapping and banding of quail is carried forward each year and gives accurate records of the movements of individuals and coveys.

Previous work has proved the value of the Santa Rita Experimental Range as a base area for quail study and quail management demonstration.

Present plans include the continued use of this range as a base area for quail management demonstration with as much expansion as is deemed feasible.

FOREST AND RANGE INFLUENCES

We were fortunate at the Parker Creek Branch Station in securing a quota of CCC boys from the A-Cross Camp (a winter headquarters) much earlier than was expected. In October, a crew of 20 boys started excavating to bed rock for the Pocket Creek Dam. Installations similar to those in Parker Creek, including weirs for both large and small flows, will be placed in Pocket Creek. When measured for a period sufficient to determine any existing differences between these similar watersheds, Pocket Creek will be

grazed in order to compare the water yield and silt discharge with that of Parker Creek, from which livestock are excluded.

Others of the CCC boys are being used for work on a road right of way-control project. The road through the Parker Creek Experimental Area is being treated in different ways, including flattening and rounding of cut and fill banks and the planting of grasses and shrubs.

Twenty-four quadrats were laid out, charted, and photographed on the "Natural Drainages", which consist of four plots of approximately 15 acres each on which the run-off from the ground surface and on bed rock and the silt discharge are measured. As soon as the results on run-off and erosion on these plots are checked to determine any differences, some of them will be grazed to varying degrees and compared with ungrazed or control areas. The quadrats were located to determine measurements of vegetation at present and throughout the study.

A large quantity of seed was collected for the Forest Service Nursery at Superior, Arizona, and for reseeding at Parker Creek. As the season had been favorable, seeds of many plants were very abundant.

The ERA program started at Parker Creek in October with four relief rollers and one ten percenter. Most of their work has been devoted to construction and maintenance projects, and to collecting seed and to revegetating small experimental drainages with potted grass plants from the Superior nursery.

A drainage map of the country surrounding the Parker Creek Experimental Area was completed in October. This area, which includes most of the installations outside the Parker Creek area, may be added to that area at some future time.

In 1934 a large area surrounding an old enclosure on a peculiar badly-eroded soil formation was fenced and considerable erosion-prevention work was done. The effect of the fencing was evidenced this year on a great increase in volume of grasses outside the old fenced research plot. Part of the increase was due to an excellent growing season, but judged by the quadrats within the old plot, from which livestock have been excluded for 10 years, most of the increase was due to protecting a very critical situation from grazing.

A study has been completed of some 20 long-time rainfall records which shows that summer precipitation in the Southwest is one of the most constant climatic features of the region. The months of July, August, and September have been separated from the rest of the year and their precipitation totaled. These three months correspond almost exactly with the period of summer thunder storms, which are of the cyclonic type and exhibit different characteristics from those of

precipitation at other seasons of the year. An investigation of the records of the 20 stations mentioned shows that, on the average, departures from the mean are very much less for summer precipitation than for precipitation during the winter season. Also, accumulated deviations computed for the summer and winter data seem to show beyond doubt that the two types of precipitation are following cyclic swings of different periods, the summer being the one of greatest length.

If the summer and winter totals for each year are arranged in the form of a frequency diagram, it is found that summer precipitation approaches the curve of "Normal Distribution", whereas winter precipitation frequently does not. This perhaps means that winter precipitation is following some physical law rather than the laws of chance and definite weather cycles, if found, will probably refer to this type of precipitation. The presence of the "Bruckner" and other semi-climatic cycles would seem to support such a suggestion. At any rate, years of extremely high or extremely low rainfall in the Southwest will usually be due to an excess or deficiency of winter precipitation, rather than summer precipitation.

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